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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/526,915	07/01/2005	Maria Therese Miglin	TH2244-PCT	7537

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EXAMINER	
WIESE, NOAH S	
ART UNIT	PAPER NUMBER
1793	
MAIL DATE	DELIVERY MODE
08/19/2008	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	10/526,915	MIGLIN ET AL.	
	Examiner	Art Unit	
	NOAH S. WIESE	1793	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *07 March 2005*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-3,6,8,11,13,14,16,18,21 and 23-30* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-3,6,8,11,13,14,16,18,21 and 23-30* is/are rejected.

7)☒ Claim(s) *6* is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *07 March 2005* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date *03/07/2005*.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Status of Application

1. The claims 1-3, 6, 8, 11, 13-14, 16, 18, 21, and 23-30 are pending and presented for the examination.

Priority

2. Acknowledgment is made of applicant's claim for foreign priority under 35 U.S.C. 119(a)-(d). The certified copy has been filed in parent Application No. PCT/US03/27995.

Information Disclosure Statement (IDS)

3. The information disclosure statement (IDS) was submitted on 03/07/2005. The submission is in compliance with the provisions of 37 CFR 1.97. Accordingly, the information disclosure statement is being considered by the examiner. Please refer to applicant's copy of the 1449 herewith.

Claim Objections

4. Claim 6 is objected to because of the following informalities: The claim refers to "The" hydrogen fuel cell, but this implies a reference to an earlier specific fuel cell that has not been discussed. "A" fuel cell is the correct language for the claim. Appropriate correction is required.

Claim Rejections - 35 USC § 103

5. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

6. The factual inquiries set forth in *Graham* **v.** *John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

7. Claims 1-2, 8, 11, 18, 21, and 24 are rejected under 35 U.S.C. 103(a) as being unpatentable over Minet et al (US 5229102) in view of Mikus et al (WO 99/18392).

Regarding **claim 1**, Minet et al teaches a steam reforming apparatus (10) comprising two concentric sections including a larger outside section functioning to heat a smaller inside section defined by membrane tube (11). The apparatus further comprises an annulus containing reforming catalyst bed between said sections (16 and 17). Annulus section (16) has an inlet for steam and vaporizable hydrocarbon (15), a flow path for hydrogen and by-product gases, and an outlet for said by-product gases (D). The outside heating section has a hydrogen-selective, hydrogen-permeable membrane (11) and an outlet for hydrogen (12a) which permeates through said

membrane from said annulus section. Minet teaches that there may be multiple membrane tubes in the reforming apparatus (see Figures 1 and 2).

Claim 1 differs from Minet et al because Minet does not teach that the outside heating section heats the reforming chamber by means of flameless combustion, but rather by flamed combustion generated in the outside heating chamber. However, it would have been obvious to one of ordinary skill in the art at the time the invention was filed to modify Minet in view of Mikus et al in order to use a flameless combustion chamber to heat the reforming chamber because Mikus teaches that flameless combustion provides a controllable heat flux into a process chamber from a heat source that has a uniform temperature and a very low creation of NO_x (see page 5, lines 1-7).

Mikus et al (see Figure 1, 3: page 8, line 3- page 10, line 15; page 10, line 25 to page 11, line 3) teaches a heat chamber comprising an inlet for preheated air or other oxidant (2) and a plurality of tubes for fuel gas (5), said tubes having opening through which the fuel gas flows (6) and is mixed with said oxidant, result in “flameless distributed combustion” (see page 8, lines 10-17), whereby uniform tailed, controlled heat is transferred to an adjacent process chamber (8) (a reforming chamber). The process chamber can comprise a catalyst steam reformer for the production of hydrogen (see page 13, lines 17-25 and page 16, lines 34 to page 17, line 30). One of ordinary skill would have been motivated to use the flameless combustion chamber taught by Mikus in place of the flamed combustion chamber taught by Minet because Mikus teaches that flameless combustion provides a controllable heat flux into a process chamber from a heat source that has a uniform temperature and a very low

creation of NO_x (see page 5, lines 1-7). One would have expected reasonable success in the modification because Minet teaches that a heating chamber is used to heat the reforming chamber, and Mikus teaches that the inventive heating chamber is used to heat a reforming chamber used for the same purpose as that of Minet. Therefore, claim 1 is obvious and not patentably distinct over the prior art of record.

Regarding **claim 2**, Minet teaches a process for producing hydrogen through the use of an apparatus that is equivalent to that of instant claim 2 when modified in view of Mikus as discussed above. Minet teaches that the temperature in the steam/hydrocarbon reforming temperature is from 300-750°C and that the pressure is from 1 to 138 bar (see claim 1). Thus, the teachings of Minet in view of Mikus meet all the process limitations of claim 2, and the claim is obvious and patentably indistinct over the prior art of record.

Regarding **claim 8**, Mikus teaches that multiple flameless combustion chambers can be employed in the reforming chamber (see Figure 4). These multiple chambers surround the multiple membrane tubes, and thus it would have been obvious to use multiple chambers when using the multiple tube configuration suggested by Minet.

Regarding **claim 11**, Minet teaches that a sweep gas is used to move the hydrogen through the apparatus and that the sweep gas is steam (see Figure 6 and column 8, lines 55-61). Minet teaches that the fuel can be methane or natural gas (see Figure 1).

Regarding **claim 18**, as can be seen from Figure 1, Mikus teaches that the FDC has a length to diameter ratio of greater than 4 to 1.

Regarding **claim 21**, because the process and apparatus taught by Minet in view of Mikus is equivalent to that of instant claims, one of ordinary skill would have been able, through routine optimization and experimentation, to adjust the purity of the carbon dioxide produced by the hydrogen production process. Thus, the addition limitation of claim 21 is obvious and does not render the claim patentably distinct over the applied prior art.

Regarding **claim 24**, Mikus teaches that multiple flameless combustion chambers can be employed in the reforming chamber (see Figure 4). These multiple chambers surround the multiple membrane tubes, and thus it would have been obvious to use multiple chambers when using the multiple tube configuration suggested by Minet.

8. Claims 3, 6, 25-26, and 30 are rejected under 35 U.S.C. 103(a) as being unpatentable over Minet et al (US 5229102) in view of Mikus et al (WO 99/18392) and in further view of Gardner (US 5527632).

Regarding **claim 3**, the claim differs from Minet in view of Mikus as applied above because the references do not teach that at least one membrane is connected to a hydride precursor region for storage. However, it would have been obvious to one of ordinary skill to modify Minet et al in view of Mikus and in further view of Gardner in order to place at least one membrane in contact with a hydride precursor region because Gardner teaches a hydrogen production apparatus wherein at least some of the hydrogen produced is diverted to a storage stage where the hydrogen is stored by forming a hydride material.

Gardner teaches an apparatus comprising a fuel cell stack, a reformer, and a hydrogen store (see Abstract). The hydrogen store section is arranged to store hydrogen from the reformate during periods that the reformer operates. The hydrogen store section comprises a metal hydride capable of storing hydrogen by forming more metal hydride material (see column 2, lines 13-15). Therefore, the hydrogen store constitutes a metal hydride precursor. Gardner teaches that the reformer can be a steam reformer or other types of reformers that convert hydrocarbons to hydrogen product gas (see column 3, lines 53-62). One of ordinary skill in the art would have been motivated to connect at least one of the membrane tubes in the Minet apparatus to a hydride storage stage as taught by Gardner because Gardner teaches that doing so allows the apparatus to supply stored hydrogen to the fuel cell in order to buffer the fast response of the fuel cell stack and the relatively slower response of the reformer during rapid load demands on the fuel cell stack (see column 2, lines 1-12). This would be obvious when using the Minet et al apparatus to supply hydrogen to a fuel cell. One would have expected reasonable success in the modification because Minet teaches a hydrogen reforming apparatus for producing hydrogen from steam and Gardner teaches that the hydrogen reforming portion of the inventive apparatus can be a similar type of reformer. Therefore, claim 3 is obvious and not patentably distinct over the prior art of record.

Regarding **claim 6**, the claim differs from Minet and Mikus because neither patent explicitly teaches that the hydrogen produced is for a fuel cell. However, as discussed about, Gardner teaches an apparatus wherein a reforming portion similar to

that taught by Minet is used to produce hydrogen for a fuel cell. This teaching would motivate one of ordinary skill in the art to use the Minet in view of Mikus hydrogen production reactor to produce hydrogen for a fuel cell, thus meeting the further limitations of claim 6.

Regarding **claim 25**, Mikus teaches that multiple flameless combustion chambers can be employed in the reforming chamber (see Figure 4). These multiple chambers surround the multiple membrane tubes, and thus it would have been obvious to use multiple chambers when using the multiple tube configuration suggested by Minet.

Regarding **claim 26**, Minet teaches that a sweep gas is used to move the hydrogen through the apparatus and that the sweep gas is steam (see Figure 6 and column 8, lines 55-61). Minet teaches that the fuel can be methane or natural gas (see Figure 1).

Regarding **claim 30**, as can be seen from Figure 1, Mikus teaches that the FDC has a length to diameter ratio of greater than 4 to 1.

9. Claims 13 is rejected under 35 U.S.C. 103(a) as being unpatentable over Minet et al (US 5229102) in view of Mikus et al (WO 99/18392) and in further view of Schieber (US 3960496).

Regarding **claim 13**, the claim differs form Minet in view of Mikus as applied above because the patents do not teach the use of baffles in the catalyst bed section. However, it would have been obvious to one of ordinary skill in the art to modify Minet

and Mikus in further view of Schieber because Schieber teaches that baffles are useful for increasing contact between to flowing reactants.

Schieber teaches an apparatus for determining corrosion rate of constituents in a flue gas (see Abstract). One stage of the apparatus involves passing the gas through a contact bed (see column 3, lines 49-53 and Figure 3). Schieber teaches that a disk/washer baffle can be used in the bed to increase gas/liquid contact (see column 3, lines 63-66). One of ordinary skill in the art would have been motivated to use these types of baffles with the Minet bed because increasing contact between the bed media and the gas to be processed would be advantageous in the Minet process. Although the processes of Minet and Schieber are for different reaction purposes, they both comprise a step of contacting a gas to be processed with a reactant, and thus they are analogous in the need to increase contact with the gas through the use of baffles. Therefore, one of ordinary skill would have expected reasonable success in the modification. Thus, claim 13 is obvious and not patentably distinct over the prior art of record.

10. Claims 14 is rejected under 35 U.S.C. 103(a) as being unpatentable over Minet et al (US 5229102) in view of Mikus et al (WO 99/18392) and in further view of Juda et al (US 5904754).

Regarding **claim 14**, the claim differs from Minet in view of Mikus because the patents do not teach that the membrane comprises a Pd-alloy layer. However, it would have been obvious for one of ordinary skill in the art to substitute an alloy according to the instant claims for the hydrogen-permeable membrane in the modified apparatus of Minet et al, on the basis of suitability for the intended use thereof, because the

substitution of known equivalent structures for providing the same function of hydrogen permeation would involve only ordinary skill in the art. Juda et al teaches a hydrogen-permeable membrane comprising an alloy of Pd and copper on a metal frame for use as a wall connecting high and low pressure chambers of a hydrogen generator (see columns 3-4, lines 1-49). The metal frame is considered to be a porous metal. Because using this membrane would constitute the use of an equivalent membrane in order to achieve equivalent results, claim 14 is obvious and not patentably distinct over the prior art of record.

11. Claims 16 is rejected under 35 U.S.C. 103(a) as being unpatentable over Minet et al (US 5229102) in view of Mikus et al (WO 99/18392) and in further view of Ruhl et al (US 5565009).

Regarding **claim 16**, Minet teaches that exemplary dimensions for a membrane tube are up to 30 feet in length and 1.5 inches in diameter (see column 4, lines 58-68). This gives a length to diameter ratio of 240. The claim differs from Minet in view of Mikus because the patents do not specifically teach the spacing between the multiple membrane tubes and the FDC tubes. However, it would have been obvious to one of ordinary skill in the art to modify Minet and Mikus in further view of Ruhl et al because Ruhl teaches spacings for a multi-tube hydrogen generating apparatus similar to the types taught by Minet and Mikus.

Ruhl teaches a reaction furnace comprising a plurality of elongated tubes defining therein an endothermic reaction flow path and a combustion flow path (see Abstract and Figure 3). The reaction furnace can be used for hydrogen production. Ruhl

teaches that the preferred spacing for the tubes is 0.3-0.5 inches (see column 6, lines 38-39). It is clear from Figure 3 that the spacing between the tubes and the insulation material (14) is similar to the spacing between tubes. This would indicate to one of ordinary skill that this spacing could fall within a range overlapping 0.25-2 inches. One of ordinary skill would have been motivated to use these spacings in the apparatus taught by Minet in view of Mikus because these patents do not teach specific spacings, leaving one to look to outside teachings for guidance. One would have expected reasonable success in the modification because both Minet and Ruhl teach apparatuses for producing hydrogen and comprising reaction tubes. Therefore, claim 16 is obvious and not patentably distinct over the prior art of record.

12. Claims 23 is rejected under 35 U.S.C. 103(a) as being unpatentable over Minet et al (US 5229102) in view of Mikus et al (WO 99/18392) and in further view of Spencer (US 6106595).

Regarding **claim 23**, the claim differs from Minet and Mikus because the patents do not teach that the produced carbon dioxide is used in an enhanced recovery operation. However, it would have been obvious to one of ordinary skill in the art to modify Minet in view of Mikus in further view of Spencer because Spencer teaches a method involving the use of produced carbon dioxide in such useful processes.

Spencer teaches methods for the removal of carbon dioxide from a multicomponent gas stream, said stream comprising hydrogen (see Abstract and column 1, lines 29-40). Spencer teaches that the carbon dioxide produced in the process can advantageously be used for such processes as enhanced oil recovery or

coal bed methane recovery (see column 8, lines 28-32). One of ordinary skill in the art would have been motivated to use the carbon dioxide produced by Minet process for one of these purposes because Spencer teaches that carbon dioxide separated from a gas stream can advantageously be used for productive purposes, rather than simply sequestered. One would have expected reasonable success in the modification because using the produced carbon dioxide for an additional task would not be expected to affect the hydrogen production process. Therefore, claim 23 is obvious and not patentably distinct over the prior art of record.

13. Claim 27 is rejected under 35 U.S.C. 103(a) as being unpatentable over Minet et al (US 5229102) in view of Mikus et al (WO 99/18392) and Gardner (US 5527632) and in further view of Schieber (US 3960496).

Regarding **claim 27**, the claim is rejected in view of Minet in view of Mikus and Gardner as discussed above, and in further view of Scheiber as is also applied above to include the use of a disk/washer baffle.

14. Claim 28 is rejected under 35 U.S.C. 103(a) as being unpatentable over Minet et al (US 5229102) in view of Mikus et al (WO 99/18392) and Gardner (US 5527632) and in further view of Juda et al (US 5904754).

Regarding **claim 28**, the claim is rejected in view of Minet in view of Mikus and Gardner as discussed above, and in further view of Juda et al as is also applied above to substitute a Pd-alloy on porous metal membrane.

15. Claims 29 is rejected under 35 U.S.C. 103(a) as being unpatentable over Minet et al (US 5229102) in view of Mikus et al (WO 99/18392) and Gardner (US 5527632) and in further view of Ruhl et al (US 5565009).

Regarding **claim 29**, the claim is rejected in view of Minet in view of Mikus and Gardner as discussed above, and in further view of Ruhl et al as is also applied above to add appropriate dimensions to the apparatus.

Conclusion

16. No claim is allowed.

17. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

18. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Noah S. Wiese whose telephone number is 571-270-3596. The examiner can normally be reached on Monday-Friday, 7:30am-5:00pm EST.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Jerry Lorengo can be reached on 571-272-1233. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic

Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/Jerry A Lorengo/
Supervisory Patent Examiner, Art Unit 1793

Noah Wiese
August 12th, 2008
AU 1793